



US 20200107785A1

(19) United States

(12) Patent Application Publication

SHAHPARNIA et al.

(10) Pub. No.: US 2020/0107785 A1

(43) Pub. Date: Apr. 9, 2020

## (54) VITAL SIGNS MONITORING SYSTEM

(71) Applicant: Apple Inc., Cupertino, CA (US)

(72) Inventors: Shahrooz SHAHPARNIA, Monte Sereno, CA (US); Erno H. KLAASSEN, Los Altos, CA (US)

(21) Appl. No.: 16/551,602

(22) Filed: Aug. 26, 2019

## Related U.S. Application Data

(63) Continuation of application No. 15/675,478, filed on Aug. 11, 2017, now Pat. No. 10,512,432.

(60) Provisional application No. 62/374,615, filed on Aug. 12, 2016.

## Publication Classification

## (51) Int. Cl.

*A61B 5/00* (2006.01)  
*A61B 5/0205* (2006.01)  
*A61B 5/024* (2006.01)  
*A61B 5/0402* (2006.01)  
*A61B 5/0408* (2006.01)  
*A61B 5/053* (2006.01)  
*A61B 5/113* (2006.01)  
*A61B 5/01* (2006.01)

## (52) U.S. Cl.

CPC ..... *A61B 5/6892* (2013.01); *A61B 5/02055* (2013.01); *A61B 5/02444* (2013.01); *A61B 5/04028* (2013.01); *A61B 5/04085* (2013.01); *A61B 5/053* (2013.01); *A61B 5/0816* (2013.01); *A61B 5/4815* (2013.01); *A61B 5/7278* (2013.01); *A61B 5/01* (2013.01); *A61B 2562/046* (2013.01); *A61B 5/02405* (2013.01); *A61B 5/02438* (2013.01); *A61B 5/113* (2013.01)

## (57)

## ABSTRACT

This relates to a monitoring system capable of measuring a plurality of vital signs. The monitoring system can include a plurality of sensors including, but not limited to, electrodes, piezoelectric sensors, temperature sensors, and accelerometers. The monitoring system can be capable of operating in one or more operation modes such as, for example: capacitance measurement mode, electrical measurement mode, piezoelectric measurement mode, temperature measurement mode, acceleration measurement mode, impedance measurement mode, and standby mode. Based on the measured values, the monitoring system can analyze the user's sleep, provide feedback and suggestions to the user, and/or can adjust or control the environmental conditions to improve the user's sleep. The monitoring system can further be capable of analyzing the sleep of the user(s) without directly contacting or attaching uncomfortable probes to the user(s) and without having to analyze the sleep in an unknown environment (e.g., a medical facility).

